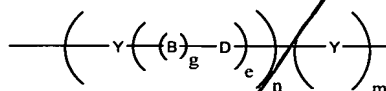


# CLAIMS

We claim:

1. A composition comprising:

- a) an electrode;
- b) at least one nucleoside; and
- c) a conductive oligomer covalently attached to both said electrode and said nucleoside, wherein said conductive oligomer has the formula:



wherein

Y is an aromatic group;

n is an integer from 1 to 50;

g is either 1 or zero;

e is an integer from zero to 10; and

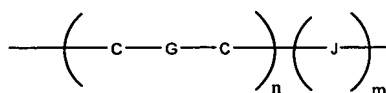
m is zero or 1;

wherein when g is 1, B-D is a conjugated bond; and

wherein when g is zero, e is 1 and D is preferably carbonyl, or a heteroatom moiety, wherein the heteroatom is selected from oxygen, sulfur, nitrogen or phosphorus.

2. A composition comprising:

- a) an electrode;
- b) at least one nucleoside; and
- c) a conductive oligomer covalently attached to both said electrode and said nucleoside, wherein said conductive oligomer has the formula:



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wherein

n is an integer from 1 to 50;

m is 0 or 1;

C is carbon;

- 5 J is carbonyl or a heteroatom moiety, wherein the heteroatom is selected from the group consisting of nitrogen, silicon, phosphorus, sulfur; and  
G is a bond selected from alkane, alkene or acetylene.

3. A composition according to claim 1 or 2 wherein said nucleoside is part of a nucleic acid.

10 4. A composition according to claim 3 further comprising a plurality of conductive oligomers each covalently attached to a nucleic acid.

5. A composition according to claim 4 wherein said nucleic acids are all the same.

15 6. A composition according to claim 4 wherein at least one of said nucleic acids is different.

7. A composition according to claim 1 or 2 wherein said covalent attachment of said conductive oligomer to said nucleoside is to the ribose or phosphate of said nucleoside.

20 8. A composition according to claim 1 or 2 wherein said covalent attachment of said conductive oligomer to said nucleoside is to the base of said nucleoside.

9. A composition according to claim 1 or 2 wherein said electrode further comprises at least one passivation agent.

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10. A composition according to claim 1 or 2 wherein said electrode further comprises a monolayer of passivation agents.

11. A composition according to claim 10 further comprising a hybridization indicator.

5 12. A composition comprising:

- a) a first electron transfer moiety comprising an electrode;
- b) a nucleic acid;
- c) a second electron transfer moiety covalently attached to said nucleic acid; and
- 10 d) a conductive oligomer covalently attached to both said electrode and said nucleic acid.

13. A composition according to claim 12 wherein said second electron transfer moiety comprises a transition metal complex.

14. A composition according to claim 12 wherein said second electron transfer moiety comprises an organic electron transfer moiety.

15. A composition according to claim 12 wherein said covalent attachment of said second electron transfer moiety is to the ribose-phosphate backbone of said nucleic acid.

16. A composition according to claim 12 wherein said covalent attachment of said second electron transfer moiety is to a base of said nucleic acid.

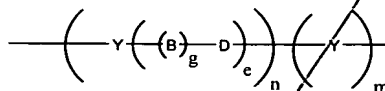
17. A composition according to claim 12 wherein said electrode further comprises at least one passivation agent.

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18. A composition according to claim 12 wherein said electrode further comprises a monolayer of passivation agents.

19. A composition according to claim 18 further comprising a hybridization indicator.

20. A composition according to claim 12 wherein said conductive oligomer has the structure:



wherein

Y is an aromatic group;

n is an integer from 1 to 50;

g is either 1 or zero;

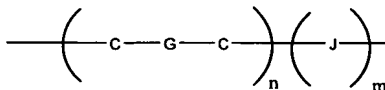
e is an integer from zero to 10; and

m is zero or 1;

wherein when g is 1, B-D is a conjugated bond; and

wherein when g is zero, e is 1 and D is preferably carbonyl, or a heteroatom moiety, wherein the heteroatom is selected from oxygen, sulfur, nitrogen or phosphorus.

21. A composition according to claim 1 wherein said conductive oligomer has the structure:



wherein

n is an integer from 1 to 50;

m is 0 or 1;

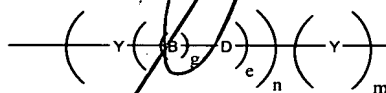
C is carbon;

J is carbonyl or a heteroatom moiety, wherein the heteroatom is selected from the group consisting of nitrogen, silicon, phosphorus, sulfur; and  
G is a bond selected from alkane, alkene or acetylene.

22. A method of detecting a target sequence in a nucleic acid sample comprising

a) applying an input signal to a hybridization complex comprising:

i) a probe nucleic acid comprising a conductive oligomer covalently attached to a first electron transfer moiety comprising an electrode and to a single stranded nucleic acid capable of hybridizing to said target sequence, said single stranded nucleic acid comprising a covalently attached second electron transfer moiety, wherein said conductive oligomer has the formula:



wherein

Y is an aromatic group;

n is an integer from 1 to 50;

g is either 1 or zero;

e is an integer from zero to 10; and

m is zero or 1;

wherein when g is 1, B-D is a conjugated bond; and

wherein when g is zero, e is 1 and D is preferably carbonyl, or a heteroatom moiety, wherein the heteroatom is selected from oxygen, sulfur, nitrogen or phosphorus; and

ii) a target nucleic acid hybridized to said probe sequence to form said hybridization complex; and

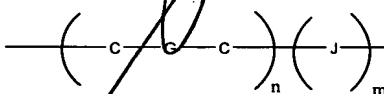
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b) detecting electron transfer between said electrode and said second electron transfer moiety, if present, as an indicator of the present or absence of said target sequence.

23. A method of detecting a target sequence in a nucleic acid sample comprising

a) applying an input signal to a hybridization complex comprising:

i) a probe nucleic acid comprising a conductive oligomer covalently attached to a first electron transfer moiety comprising an electrode and to a single stranded nucleic acid capable of hybridizing to said target sequence, said single stranded nucleic acid comprising a covalently attached second electron transfer moiety, wherein said conductive oligomer has the formula:



wherein

n is an integer from 1 to 50;

m is 0 or 1;

C is carbon;

J is carbonyl or a heteroatom moiety, wherein the heteroatom is selected from the group consisting of nitrogen, silicon, phosphorus, sulfur; and

G is a bond selected from alkane, alkene or acetylene; and

ii) a target nucleic acid hybridized to said probe sequence to form said hybridization complex; and

b) detecting electron transfer between said electrode and said second electron transfer moiety, if present, as an indicator of the present or absence of said target sequence.

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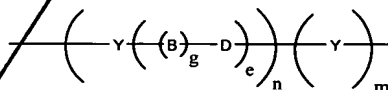
24. A method according to claim 22 or 23 further comprising the step of hybridizing said probe nucleic acid to said target nucleic acid prior to said applying step.

25. A method according to claim 22 or 23 wherein said input signal includes the use of a co-redoxant.

26. A method of detecting a target sequence in a nucleic acid wherein said target sequence comprises a first target domain and a second target domain, said method comprising:

a) hybridizing a first probe nucleic acid to said first target domain, if present, to form a hybridization complex, wherein said first probe nucleic acid comprises:

i) a conductive oligomer covalently attached to a first electron transfer moiety comprising an electrode and to a single stranded nucleic acid capable of hybridizing to said target sequence, wherein said conductive oligomer has the formula:



wherein

Y is an aromatic group;

n is an integer from 1 to 50;

g is either 1 or zero;

e is an integer from zero to 10; and

m is zero or 1;

wherein when g is 1, B-D is a conjugated bond; and

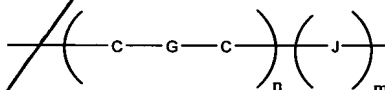
wherein when g is zero, e is 1 and D is preferably carbonyl, or a heteroatom moiety, wherein the heteroatom is selected from oxygen, sulfur, nitrogen or phosphorus;

- b) hybridizing a second single stranded nucleic acid comprising a covalently attached electron transfer moiety to said second target domain; and
- c) detecting electron transfer between said electrode and said second electron transfer moiety, if present, as an indicator of the present or absence of said target sequence.

27. A method of detecting a target sequence in a nucleic acid wherein said target sequence comprises a first target domain and a second target domain, said method comprising:

- a) hybridizing a first probe nucleic acid to said first target domain, if present, to form a hybridization complex, wherein said first probe nucleic acid comprises:

- i) a conductive oligomer covalently attached to a first electron transfer moiety comprising an electrode and to a single stranded nucleic acid capable of hybridizing to said target sequence, wherein said conductive oligomer has the formula:



wherein

n is an integer from 1 to 50;

m is 0 or 1;

C is carbon;

J is carbonyl or a heteroatom moiety, wherein the heteroatom is selected from the group consisting of nitrogen, silicon, phosphorus, sulfur; and

G is a bond selected from alkane, alkene or acetylene ; and

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- b) hybridizing a second single stranded nucleic acid comprising a covalently attached electron transfer moiety to said second target domain; and
- c) detecting electron transfer between said electrode and said second electron transfer moiety, if present, as an indicator of the present or absence of said target sequence.

28. A method for attaching a conductive oligomer to a gold electrode comprising

- a) adding an ethyl pyridine protecting group to a sulfur atom attached to a first subunit of said conductive oligomer.

29. A method according to claim 28, further comprising adding additional subunits to form said conductive oligomer.

30. A method according to claim 29, further comprising adding at least first nucleoside to said conductive oligomer.

31. A method according to claim 30, further comprising adding additional nucleosides to said first nucleoside to form a nucleic acid.

32. A method according to claim 29 or 31, further comprising attaching said conductive oligomer to said gold electrode.

~~33. A conductive oligomer with a ethyl pyridine protected sulfur atom.~~

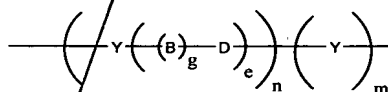
34. A method of making a composition according to claim 1, 2 or 12 comprising:

- a) providing a conductive oligomer covalently attached to a nucleoside; and
- b) attaching said conductive oligomer to said electrode.

35. A method of making a composition according to claim 1, 2 or 12 comprising:

- a) attaching a conductive oligomer to an electrode; and
- b) attaching at least one nucleotide to said conductive oligomer.

36. A composition comprising a conductive oligomer covalently attached to a nucleoside, wherein said conductive oligomer has the formula:



wherein

Y is an aromatic group;

n is an integer from 1 to 50;

g is either 1 or zero;

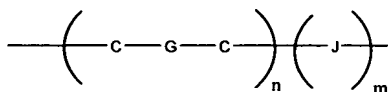
e is an integer from zero to 10; and

m is zero or 1;

wherein when g is 1, B-D is a conjugated bond; and

wherein when g is zero, e is 1 and D is preferably carbonyl, or a heteroatom moiety, wherein the heteroatom is selected from oxygen, sulfur, nitrogen or phosphorus.

37. A composition comprising a conductive oligomer covalently attached to a nucleoside, wherein said conductive oligomer has the formula:



wherein

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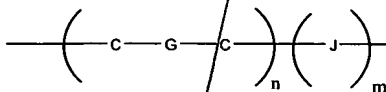
J is carbonyl or a heteroatom moiety, wherein the heteroatom is selected from the group consisting of nitrogen, silicon, phosphorus, sulfur; and

38. A composition according to claim 36 or 37 further comprising a hybridization indicator.

$$\left( \left( Y \left( (B)_g D \right)_e \right)_n \right)_m$$

wherein when g is zero, e is 1 and D is preferably carbonyl, or a heteroatom moiety, wherein the heteroatom is selected from oxygen, sulfur, nitrogen or phosphorus.

40. A composition comprising a conductive oligomer covalently attached to a phosphoramidite nucleoside, wherein said conductive oligomer has the formula:



wherein

n is an integer from 1 to 50;

m is 0 or 1;

C is carbon;

5 J is carbonyl or a heteroatom moiety, wherein the heteroatom is selected from the group consisting of nitrogen, silicon, phosphorus, sulfur; and

G is a bond selected from alkane, alkene or acetylene

41. A composition comprising a conductive oligomer covalently attached to a CPG-nucleoside.

10 42. A composition comprising a nucleoside covalently linked to a metallocene.

43. A composition according to claim 42 wherein said metallocene is ferrocene or substituted ferrocene.

44. A composition according to claim 42 wherein said metallocene is covalently attached to the base of said nucleoside.

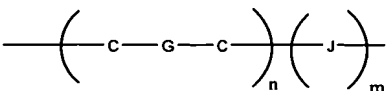
15 45. A composition comprising:

a) an electrode;

b) at least one metallocene; and

c) a conductive oligomer covalently attached to both said electrode and said metallocene, wherein said conductive oligomer has the

20 formula:



wherein

n is an integer from 1 to 50;

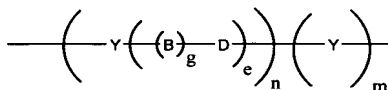
m is 0 or 1;

C is carbon;

- 5 J is carbonyl or a heteroatom moiety, wherein the heteroatom is selected from the group consisting of nitrogen, silicon, phosphorus, sulfur; and  
G is a bond selected from alkane, alkene or acetylene

46. A composition comprising:

- 10 a) an electrode;  
b) at least one metallocene; and  
c) a conductive oligomer covalently attached to both said electrode and said metallocene, wherein said conductive oligomer has the formula:



wherein

- 15 Y is an aromatic group;  
n is an integer from 1 to 50;  
g is either 1 or zero;  
e is an integer from zero to 10; and  
m is zero or 1;

- 20 wherein when g is 1, B-D is a conjugated bond; and  
wherein when g is zero, e is 1 and D is preferably carbonyl, or a heteroatom moiety, wherein the heteroatom is selected from oxygen, sulfur, nitrogen or phosphorus.

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